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Parasitism of *Siphoninus phillyreae* (Homoptera: Aleyrodidae) by Aphelinid Parasitoids at Different Locations in Egypt

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Abstract.—Seven species of aphelinid parasitoids (Hymenoptera: Aphelinidae) were reared from second and third larval stages and pupae of pomegranate whiteflies, *Siphoninus phillyreae* (Haliday) (Homoptera: Aleyrodidae) from three locations in Egypt, during a one year survey (June 94–June 95). Three species, *Eretmocerus mundus* Mercet, *Encarsia davidi* Viggiani and Mazzone, and *E. galilea* Rivnay, were reported from Arish (Northeast Egypt). Parasitism was greatest (45.7%) in Arish during September 1994, out of which 38% was caused by *E. mundus*. *Encarsia inaron* (Walker) was the dominant parasitoid of *S. phillyreae* in Giza (Central Egypt) and Assiut (Upper Egypt), with average parasitism rates of 38 and 46.5% over the year, respectively. In Giza, total parasitism reached a maximum of 80% during August 1994, with *Encarsia inaron* being responsible for 66.1%. In Assiut, parasitism peaked at 93.1% in August 1994 with *E. inaron* accounting for 78% of the total. *Eretmocerus diversicilatus* Silvestri and *Encarsia lutea* (Masi) were reported only from Giza. *Eretmocerus corni* Haldeman was reported only from Assiut. These species had much less impact than *E. inaron* in both locations. The presence of different parasitoids at different locations was attributed to geographical factors as well as tolerance of the parasitoids to weather factors and probably availability of alternative hosts. A key for the reported parasitoids is presented.

The pomegranate whitefly, *Siphoninus phillyreae* (Haliday) (Homoptera: Aleyrodidae), is the most important pest of pomegranate in Egypt (Priesner and Hosny 1932). This insect's host range is restricted to deciduous fruit crops (Byrne et al. 1990). In Egypt, the host range of *S. phillyreae* includes apple, *Pyrus malus* L.; pear, *Pyrus communis* L.; quince, *Pyrus cydonia* L., and pomegranate, *Punica granatum* L. (Abd-Rabou 1990). Pomegranate orchards extend from the north coast to southern Egypt. Pomegranate leaves heavily infested with *S. phillyreae* have the demand for fluid transport substantially increased beyond the tree's normal capacity to respond. The loss of phloem fluids certainly represents a loss of potential productivity and probably contributes to the reported reduction in fruit size (Costacos 1963). Elwan (1982) studied the biology of *S. phillyreae* and showed that its developmental period varied according to temperature and relative humidity. Various aphelinid parasitoids (Hymenoptera: Aphelinidae) have been reported from *S. phillyreae*, including *Encarsia inaron* (Walker), *E. siphonini* Silvestri, *E. galilea* Rivnay, *E. hispida* De Santis, *E. pseudopartenopea* Viggiani and Mazzone and *Eretmocerus corni* Haldeman (Priesner and Hosny 1940; Mentzeloz 1967; Viggiani and Mazzone 1980a,b; Viggiani and Battaglia 1983; Rivnay and Gerling 1987; Polaszek et al. 1992). *Punica granatum* is a deciduous fruit crop which defoliates in winter.

The purpose of this study was to monitor the rate of aphelinid parasitism on *S. phillyreae* infested pomegranate leaves in three distinctive regions in Egypt, to assess the impact of biological control on the whitefly, and to determine in what ways it can be improved.

MATERIALS AND METHODS

Second and third larval stages and pupae of *Siphoninus phillyreae* were sampled

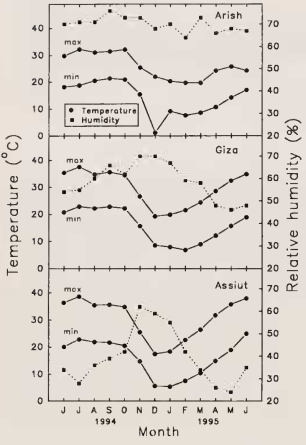

Fig. 1. Monthly mean maximum and minimum temperatures and percent relative humidity at the three locations over the survey period.

on pomegranate leaves collected monthly (30 infested leaves per sample) from one site representing each of three distinctive regions in Egypt. The number of trees varied by location. Arish is located in Northeast Sinai (i.e., coastal area), Giza is located south of Nile Delta and Assiut in southern Egypt. Environmental data were obtained from local weather stations and mean monthly values were plotted in Fig. 1. Pomegranate trees in the three locations did not receive any chemical treatments except at the Assiut area, which was sprayed for stem borers during defoliation (i.e., January–February 1995). Defoliation time was longer in the Arish area than at Giza or Assiut. No data for the whitefly is presented during the defoliation periods. Pomegranate leaves were transferred to the laboratory in well-ventilated boxes. *S. phillyreae* eggs and first larval stages were

Table 1. Percent parasitism of *Siphoninus phillyreae* by different aphelinid parasitoids in Arish, Egypt.

Date	Whitefly individuals/ leaf	Percent parasitism		
		Er. mundus	*En. davidi*	*En. galilea*
June 1994	41.6	17.0	1.5	0
July	66.6	23.0	4.5	0.3
August	110.0	31	8	0.8
September	100.0	38	6.5	1.2
October	70.4	27	3	2.0
November	35.0	10	0.5	0.5
December	16.6	5	0	0
January 1995	—	—	—	—
February	—	—	—	—
March	—	—	—	—
April	—	—	—	—
May	—	—	—	—
June	32.6	13	1.1	0.8

— Data was not available because of defoliation.

eliminated as well as other insects. Total number of *S. phillyreae* individuals in each stage were recorded per leaf. Each leaf was stored in well-ventilated glass emergence tube and monitored daily for parasitoid emergence. Parasitoid adults were slide mounted in Hoyer's medium and identified to species, and a diagnostic key was constructed for their identification.

RESULTS

Parasitoid species emerging from samples of *S. phillyreae* on pomegranate varied according to the area from which they were collected in Egypt. In the Northeastern Sinai, where Arish is located, *Eretmocerus mundus* Mercet, *Encarsia davidi* Viggiani, and *E. galilea* parasitized an average of 25% of the total *S. phillyreae* population. *Eretmocerus mundus* was responsible for 20.5% of the total parasitism and the other 4.4% by the other two parasitoids (Table 1). In the Arish area, parasitism peaked at 45.7% in September (Table 1). The parasitoid species reported from Arish area (i.e. *E. mundus, E. davidi and E. galilea*) were not recovered from samples in Giza or Assiut.

In Giza (Central Egypt), *S. phillyreae* was parasitized by *E. inaron, Eretmocerus diversicilatus* Silvestri, and *E. lutea* (Masi) at

Table 2. Percent parasitism of *Siphoninus phillyreae* by different aphelinid parasitoids in Giza, Egypt.

Date	Whitefly individuals/ leaf	Percent parasitism		
		En. inaron	*Er. diversi-scalatus*	*En. lutea*
June 1994	27.4	24.1	1.5	0.5
July	33.7	39.0	4.5	2.0
August	56.3	66.1	8.1	6.0
September	68.9	69.0	6.5	3.5
October	66.4	53.1	3.0	1.5
November	30.6	9.0	0.5	1.0
December	10.6	3.1	0.0	0.0
January 1995	—	—	—	—
February	—	—	—	—
March	—	—	—	—
April	—	—	—	—
May	17.3	0	0	0
June	22.1	25.0	1.1	1.0

— Data was not available because of defoliation.

Table 3. Percent parasitism of *Siphoninus phillyreae* by different aphelinid parasitoids in Assiut, Egypt.

Date	Whitefly individuals/ leaf	Percent parasitism	
		En. inaron	*Er. corni*
June 1994	70.1	50.0	9.0
July	113.8	73.0	12.1
August	189.0	78.0	15.1
September	177.8	66.0	17.1
October	140.4	45.1	19.1
November	100.0	20.0	14.0
December	20.7	18.0	10.0
January 1995	—	—	—
February	—	—	—
March	—	—	—
April	10.3	0.0	0.0
May	40.3	32.2	4.1
June	21	37.1	5.1

— Data was not available because of defoliation.

average rates of 38, 4.5, and 2.2%, respectively (Table 2). The maximum rate of parasitism reached 80% during August 1994, of which *E. inaron* was responsible for 66.1% of the total.

In Assiut, parasitism averaged 46.5% by *E. inaron* and 12% by *Eretmocerus corni* (Table 3). Parasitism peaked to 93.1% during August 1994, where *E. inaron* was responsible for 78% of the total.

All reported parasitoids were primary parasitoids except for *Encarsia* males that are known to be hyperparsites on females of their own species or other parasitoid species (Viggiani 1981). No hyperparasitism was observed.

DISCUSSION

The three areas of Egypt surveyed were distinctive in their locations as well as their weather (Fig. 1). The Arish area is located in Northeast Sinai and can be characterized by colder and longer winters, and higher relative humidity than in Giza or Assiut. Also, Arish is isolated from the other two locations by the vast desert area of the Sinai, which may account for difference in the *S. phillyreae* parasitoid complex. The parasitoid species collected from Arish area were not reported in the other two locations. *E. inaron* was the dominant parasitoid of *S. phillyreae* in both Giza and Assiut. Both of these areas are in the Nile River Valley, south of Nile Delta with Assiut about 300 km south of Giza. *Encarsia lutea* and *E. diversicilatus* were obtained only in samples from Giza, while *E. corni* was recovered only from Assiut. Higher temperature in Assiut may correlate to both higher whitefly populations and higher rates of parasitism.

Encarsia davidi was recorded by Abd-Rabou (1994) as a parasitoid of *Aleurolobus niloticus* Priesner and Hosny on *Ziziphus spinachristi* in Egypt. *Encarsia galilea* was recorded by Abd-Rabou (1994) as a parasitoid of *S. phillyreae* on *P. granatum.* Priesner and Hosny (1932) recorded *Encarsia inaron* as a parasitoid of *S. phillyreae* on *P. granatum* and indicated a rate of parasitism as high as 80%. In our survey, the peak of parasitism by *E. inaron* occurred in September (69%) and in August (78%) in Giza and Assiut, respectively.

Encarsia lutea (Masi) was recorded by Abdel-Fattah et al. (1984) as a parasitoid of *Bemisia tabaci* (Genn.) on tomato plants, whereas *Eretmocerus corni* was recorded by Priesner and Hosny (1940) as a para-

sitoid of *B. tabaci* on *Lantana camara*. *Eretmocerus diversicilatus* was recorded for the first time from Egypt associated with *B. tabaci* by Khalifa and El-Khidir (1965), and *Eretmocerus mundus* has been recorded from Egypt on *B. tabaci* by El-Helay et al. (1971). In the present study, *E. mundus* was the dominant species in the Arish location, with the peak parasitism occurring in September (38%).

Parasitoid tolerance to different ranges of temperature and relative humidity is not clearly known. The colder and longer winters of Arish, as well as lower humidity in Assiut, may be limiting factors controlling the presence and absence of each parasitoid species of *S. phillyreae*. In addition, the availability of alternate hosts for the parasitoids in the same area is probably another factor. Terminology used in the key follows that of Polaszek et al. (1992).

KEY TO APHELINID PARASITOIDS OF *SIPHONINUS PHILLYREAE* FROM EGYPT

1. Antennal flagellum 3-segmented in female, club one elongate segment, tarsi 4- segmented, male flagellum 1-segmented ..... Genus ***Eretmocerus*** 2
– Antennal flagellum 6-segmented in female, club 2–3 segments, tarsi 5-segmented, male flagellum 5 or 6-segmented ..... Genus ***Encarsia*** 4
2. Mesoscutum with 2 pairs of setae, male pedicel dark brown 3
– Mesoscutum with 3 pairs of setae, first funicle segment triangular, club 6–7 times as long as wide, male pedicel yellow ..... ***E. corni*** Haldeman
3. First funicle segment quadrate, second funicle segment longer than wide, submarginal vein with 3 seta ..... ***E. mundus*** Mercet
– First funicle segment triangular, second funicle segment transverse, submarginal vein with 2 setae ..... ***E. diversicilatus*** Silvestri
4. Head and mesosoma dark brown to black with 6–10 pairs of setae, metasoma yellow, antennal club 2-segmented ..... ***E. inaron*** (Walker)
– Entire body yellow or orange, or nearly so, metasoma tergite I often infuscate, antennal club 3 segmented 5
5. Valvular III dark brown, first funicle segment quadrate or wider than long, male funicle segments F1–F3 expanded 6
– Valvular III yellow, first funicle cylindrical, 1.6–2.3 as long as wide, male unknown .... ***E. galilea*** Rivnay
6. Valvular III short, as long as width at base and 0.3 times as long as ovipositor, tibia II 1.0–1.1 times as long as ovipositor ..... ***E. lutea*** (Masi)
– Valvular III elongate, 2 times as long as width at base and 0.4 times as long as ovipositor, tibia II 0.8 times as long as ovipositor ..... ***E. davidi*** Viggiani and Mazzone

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